Appendix A. Work Plan for Final Model Modifications

Missouri Tributary's Groundwater Model Update

The Nebraska Department of Natural Resources (NeDNR) contracted with Olsson Associates to conduct a review of the Lower Plate/Missouri Tributaries Groundwater Model (LPMTGW). This review identified a number of inconsistencies between the 2014 model work plan and the final model product. NeDNR plans to work to address those inconsistencies through modification to the existing model structure. This work plan identifies the key aspects of the model and model calibration process that will be reworked prior to final publication of the model.

Model Package Modifications

The three primary structural inconsistencies between the final model report and 2014 model work plan that will be addressed are:

1. Redevelopment of the hydraulic conductivity distribution
2. Development of a separate ET Package
3. Reduction of non-physically based zonation constraints on water budget terms and corresponding model inputs.

Redevelopment of the Hydraulic Conductivity Distribution

The initial hydraulic conductivity values will be redeveloped and established in a manner more consist with those identified in the 2014 model work plan. Calibration of the hydraulic conductivity values will be completed through development of zones and pilot points. Zonation will be developed to distinguish alluvial aquifer areas (generally higher conductivity areas) from upland aquifer areas (generally lower conductivity areas). Pilot points will be placed in a manner designed to capture the distribution of conductivity values identified in the 2014 model work plan. Calibration of the conductivity values will be limited to an agreed upon range, likely no greater than 50 feet/day (plus/minus 25 feet/day).

Development of a Separate ET Package

The process for representing groundwater evapotranspiration currently flows through elements of the watershed model. To limit this complexity and more completely integrate groundwater evapotranspiration into the model a new MODFLOW ET package will be developed. The initial ET package will be developed based on the distribution of likely high water table locations as identified in the National Wetlands Inventory or similar landuse coverage. The maximum ET rates will be established based on available sources identified by NeDNR and an initial extinction depth will be established (likely 5 to 10 feet). Model calibration may dictate that the initial parameters such as the maximum ET rate and extinction depth are modified as calibration proceeds.

Reduction of Non-physically Based Zonation Constraints on Water Budget Terms and Corresponding Model Inputs.

Fourteen "coefficient zones" and 74 "runoff zones" have been created to allow for use of parameters within the watershed model to refine model inputs. In an effort to ensure consistency with physically based parameters new zones will be established to represent physical process differences (soils, landuse, slope, etc.) that may impact groundwater model inputs, mainly recharge. Calibration of model inputs (recharge and pumping) will focus on ensuring that those physical process elements are not modified beyond reasonable constraints.

Calibration and Review Process

The three primary model calibration process inconsistencies between the final model report and 2014 model work plan that will be addressed are:

1. A more extensive review of existing well hydrograph data for qualitative and semi-quantitative calibration
2. Use of reach-gain terms for quantitative calibration of river reach gains
3. Review of synoptic measurement data in conjunction with minor stream segments

A more extensive review of existing well hydrograph data for qualitative and semi-quantitative calibration

The current version of the model focused calibration activities on a limited set of available well hydrographs. The revised approach will strive to use all wells in the study area that have data that spans at least ten years and that have been measured at least ten times during the model calibration period. This will increase the number of wells that will be included from about 40 to about 300 and increase the available data by a factor of approximately 10, essentially utilizing over 95% of the available data. However, some of these wells were measured significantly more often than the typical measurement frequency of once or twice a year. While the complete hydrographs for these wells will be useful for qualitatively comparing the measurements to the model predicted water levels, care will be exercised during the PEST simulations to balance the relative measurement frequency for the data used to compute the objective function so as to not significantly bias the PEST outcomes towards the wells with the most data.

Use of reach-gain terms for quantitative calibration of river reach gains

The current model baseflow calibration process focused on evaluation of total flow for the larger streamflow segments represented in the model. The revised approach will focus baseflow calibration of the larger streams to matching the gains in stream baseflow in the stream gage segments. Calibration to these baseflow gains will recognize the high degree of uncertainty that may be represented in the monthly quantities and rather focus on seasonal quantities and trends in baseflow conditions.

Review of synoptic measurement data in conjunction with minor stream segments

The current model baseflow calibration process did not appear to utilize the recent streamflow synoptic survey data that was collected by NeDNR. The revised calibration approach will include a review of model baseflow quantity estimates as compared to synoptic survey locations. The goal of this calibration element will be to ensure that stream segments represented in the model match those areas where streamflow was identified and that the overall quantity of baseflow discharge within the model is of similar magnitude to the observed synoptic data.